The opening sections deal briefly with the nature, use, and advantages of the nitrogen, phosphorus, and potash groups of fertilisers. Under the heading of "Mixed Fertilisers" the many questions arising out of farmyard manure and its storage are discussed—the manure heap is still the most unscientific part of the farm—also the vexed subject of the utilisation of sewage.

Part ii. deals with soils and their properties, and the author is able in relatively few words to give a comprehensive account of this vast subject, in which the application of science has made such strides, though it remains more than ever true that the cultivator of the soil himself must determine in every case the dividing line between what is practicable and what is not. The sections on special soil improvers and soil reclamation are most suggestive.

Under the heading "Crops" an outline of photosynthesis is given, followed by sections on the formation of carbohydrates, oil, nitrogenous bodies, and miscellaneous substances, such as tea, coffee, rubber, and fruit. These are all well done, and give a great deal of information in a limited space, much of which is not so generally known to chemists as is perhaps desirable. A point of interest in connection with the increasing production of oil-cake in this country is the opposition of cattle to take readily to new-fashioned food.

Perhaps the most interesting section is that entitled "The Production of Meat." The grazing animal is a machine for converting food of low value to human beings into high-grade food, and there is much to be learnt before this process is fully understood and efficiently controlled. The variety of simple forms of combined nitrogen is large, but whereas some of them are plentiful, others are scarce, and possibly their supply to the animal has to be considered. At present no practical way of obtaining a clear idea of the value of the different proteins in the foods has been discovered. Similarly the production of fats in this country is one of the greatest needs for the future, particularly in times when sea transport is restricted. The climate is unsuitable for the production of vegetable fats, and far greater attention will have to be paid to the pig from this point of view. In discussing future development the financial aspects and the labour question are not forgotten.

Enough has been said to indicate that Mr. Collins has produced a book which is both novel and suggestive, and it deserves to be very widely read.

(6) Without the solid foundation of fact, chemical theories of any kind would not lead far, and it is therefore appropriate to include here a mention of the newest volume of Dr. Friend's "Text-book of Inorganic Chemistry"—namely, that entitled "Carbon and its Allies," by Dr. Caven. Inorganic chemistry to-day is vastly more interesting than a generation ago, when physical chemistry was all but unknown, and the increasing technical importance of many of the less common elements has also added to their interest to the chemist. The elements dealt with are carbon, silicon, titanium, zirconium, thorium, germanium, tin, and lead. For carbon 150 pages of the text are required, which allow of detailed consideration of the allotropic forms, of coal, the simple hydrocarbons, coal-gas, and carbon dioxide. The section dealing with the last is particularly full, and may be quoted as typical of the thoroughness with which the book has been prepared.

The chemistry of silicon has made notable advances during the last few years, largely owing to the researches of British workers on the problems of its relation to carbon, which will be found to be fully considered.

An interesting section is that concerning the constitution of the silicates, which are more definite in composition than the acid itself. The hexite-pentite theory of the Aschs is briefly replained. The author might have made fuller reference to the present industrial uses of silica and of the alkali silicates, the latter especially having very wide application. Titanium is in the main a scientific curiosity, practical interest being limited to its use in steel. The same applies to zirconium, but now that the subject of refractory materials is receiving greater attention we may expect to hear more of it. Thorium is of importance from two points of view—namely, on account of its radio-activity and the use of its oxide in the manufacture of incandescent gas mantles. Both subjects receive very full treatment, and the chapter is one of the most valuable in the book.

Dr. Caven is to be congratulated on having done his work well, and his book will be found to be a storehouse of useful knowledge by all desiring information about the metals mentioned. It is well arranged and clearly printed, both of which facts add much to its usefulness.

E. F. ARMSTRONG.

A THEORIST'S OUTLOOK.

Essays in Scientific Synthesis. By E. Rignano. Pp. 254. (London: G. Allen and Unwin, Ltd., 1918.) Price 7*s.* 6*d.* net.

THE editor of the well-known international journal of science, *Scientia*, has done well to give Englishmen, whom he regards as "not attracted by broad generalisations," an opportunity of appreciating in their own language some of the stimulating essays that come from his untiring pen. They deal, indeed, with generalisations of the loftiest scope, but those who cannot follow the author up all the peaks which he seeks to climb will be rewarded by many an interesting view of the solid ground of facts below. The bond uniting the eight essays is that they express the synthetic spirit, and that they are animated by the object "of demonstrating the utility in the biological, psychological, and sociological fields of the theorist, who, without having specialised in any particular branch or subdivision of science, may nevertheless bring into those spheres that synthetic and unifying vision which is brought by the theorist-mathematician, with so much success, into the physico-chemical field of science." We are not sure that "theorist" is the proper title for the generalising thinker like Herbert Spencer, or that Dr. Rignano sufficiently realises the dangers of the synthetician's ambition, but we agree with his protest against the narrow view that all experimentation must be done in a laboratory. What the author really stands for is, that complementary to the work of the experimentalist is the work of the quiet thinker who has had sufficient discipline in scientific method on one hand, and in metaphysical analysis on the other. For this function the book before us is an apologia, and, while it naturally illustrates the risks of the adventure, it also clearly demonstrates its rewards. The second essay gives a luminous exposition of the synthetic value of the evolution-theory. "No other theory, perhaps, has succeeded in bringing into one general survey so many disparate phenomena, and in co-ordinating in one complete complex the numerous individual theories which hold their own in widely differing branches of science, and which, at first sight, seem to have nothing in common." We wish, however, that the author had said something about the fallacy so frequently involved in applying the same word "evolution" to historical sequences which have little in common except that they are processes of becoming.

The central part of the book is undeniably difficult, but it is, as an attempt at least, of great importance. It gives an outline of a mnemic theory of life, which the author has previously expounded in his work on "centro-epigenesis." Let us try to state the main idea without too much of its special terminology. It is quite certain that a relatively simple living creature without any nerve-centres can somehow enregister the results of its experience so that subsequent actions are influenced. That is a relatively simple "mnemic" phenomenon. A set of cells that have taken to some novel metabolic routine, such as secreting an anti-body to some toxin, may keep up the habit long after the original stimulus has ceased to operate. That is another illustration of "mnemic" phenomena. There is some sort of functional inertia in individual organisms—a tendency which in its most fundamental expression is simply to persist in a given phase of moving equilibrium (the word "stationary" used in the translation does not suggest the right idea). Now if the germinal substance is made up of "specific potential elements" which act as accumulators of particular modes of energy—"representative currents," as it is said—it may also be that in the course of the individual development of the offspring there is an activation of these and an irradiation from the centre outwards so that a formative influence is exerted. "The substance of which each of these specific potential elements is composed, which is capable of giving as discharge a single well-determined specific nervous current, is still one and the same substance which this nervous current, when it acts as a 'charging' current, can in its turn form and deposit." In this is found the explanation of the transmission of acquired characters (supposing that to be a fact) and of the recapitulation of phylogenetic stages in ontogeny. It appears to us that the specific form of Dr. Rignano's theory is not in grips with the facts, but to those who believe that experience counts in racial evolution in some other way than either Lamarck or Darwin recognised, every adventure in mnemic theory will be welcome. As to the nervous energy referred to, with its fundamental property of specific accumulation, it is said to obey the general laws of energetics, but is regarded as a monopoly of living organisms. In other words, there is a specific vital energy, as the late Prof. Assheton also maintained.

Organisms strive and cry, they exhibit endeavour and initiative, they are swayed by "affective tendencies." The author seeks to show that these are fundamentally referable to the tendency to maintain physiological integrity or equilibrium. Inborn affectivities with a mnemic basis express themselves in habitual actions, and new habits form new affectivities of the most varied nature. If "habit is second nature," then, inversely, "nature" is nothing but "first habit"—a deliverance that would have pleased Samuel Butler. The author recognises, of course, the complications that are added in organisms with fine brains and strong emotions, that secondary affectivities may come to overrule the primary ones, and so on; but all the apparent "finalism" of life rests on the mnemic property of living substance, which is admitted to be beyond chemical and physical formulation.

We have left too little of our allotted space for the remaining chapters. In answer to the ambitious question, "What is consciousness?" the author maintains that a psychic state is not in itself conscious or unconscious, but becomes one or the other only in relation to some other psychic state. As to the *rôle* of religion, it is argued that its social functions are gradually waning away, having been replaced by other influences. For the individual, however, it is likely to remain, in some form or other, as an expression of man's unconquerable desire to push beyond the frontiers of science and in a stretching out of his hands to relieve his surcharged emotion. Against the fatalistic dogma of "historic materialism" which exaggerates the "inevitable march" of economic processes, the author argues cogently that even in the recognition of the struggle between classes there is on the part of extreme Marxists a welcome contradiction in terms, for the agency of free men with ideas and ideals is thus admitted to be a factor that counts. In spite of its exaggerations, however, the fundamental idea of "historic materialism" has had an important synthetic function in binding together the previously disconnected disciplines of economics, law, and history. The book ends with a dispassionate discussion of Socialism and its future and with a note of hopefulness in recognising the, in part compulsory and in part spontaneous, enlargement and sensitising of the social conscience. We hope to see a continuation of these valuable essays in scientific synthesis, and we would take this opportunity of wishing the author success in his disinterested editorship of *Scientia*, which is an indubitable factor towards true pacifism.

MATHEMATICAL BOOKS.

(1) *Theory of Maxima and Minima.* By Prof. Harris Hancock. Pp. xiv+193. (Boston (Mass.), London, etc.: Ginn and Co., 1917.) Price 10*s*. 6*d*. net.

(2) *Analytic Geometry and Calculus.* By Profs. F. S. Woods and F. H. Bailey. Pp. xi+516. (Boston (Mass.), London, etc.: Ginn and Co., 1917.) Price 10*s*. 6*d*. net.

(1) THE theory of maxima and minima contains pitfalls into which have fallen such well-known mathematicians as Lagrange, Bertrand, Serret, and Todhunter. A peculiar interest, therefore, is attached to the subject, and the reader will find Prof. Hancock's book well worth his study. Except that there is no reference to calculus of variations, the author has succeeded in covering the ground fairly thoroughly, and that without allowing the argument to be anywhere tedious. He gives many references, and a few quite interesting examples.

After a short investigation of maxima and minima of functions of a single variable, he gives in some detail the methods of Scheeffer and von Dantscher, which introduced rigour into the discussion of functions of two or three variables. The theory here is intimately connected with the theory of quadratic forms and singularities of higher plane curves. The author seems not to have read such books as Bromwich's "Quadratic Forms," Hilton's "Linear Substitutions," or Muth's "Elementartheilar," which would have enabled him in places to simplify his treatment of quadratic forms. In tracing a plane curve near a singularity, the author should have made use of Newton's diagram. He should also have avoided such a phrase as "cusps of the first and second kind," which implies that the cusps in question are comparable, whereas the latter is a singularity of much higher complexity than the former.

The chapter on relative maxima and minima is especially interesting. The discussion usually given in the text-books is very scanty, and the fuller treatment here given is very welcome. A valuable point is made in §§ 98–107. The usual proof that the maximum triangle inscribed in a given circle is equilateral runs as follows: "If not, suppose ABC to be the greatest triangle. If $AB \neq AC$, let D bisect the arc BAC. Then the triangle $BDC > BAC$, etc." Is this argument admissible? The reader may compare the following reasoning, due to an Italian author: "Unity is the greatest integer. For, if not, suppose n ($\neq 1$) the greatest. Then $n^2 > n$, etc." The proofs run parallel, but the tacit assumption (a greatest triangle or integer exists) is lawful in one case and not in the other.

(2) This work is a revision and abridgment of the authors' two-volume "Course in Mathematics for Students of Engineering and Applied Science," and is intended to occupy a two years' course for an average college class. The book does not give the impression of being especially suited to the needs of students of applied science, except for the fact that examples are included on finding centre of gravity, centre of pressure, and so on. In the main the book is apparently simply a course on pure mathematics designed for the American undergraduate. As such it may be commended as quite clear and readable, and it is furnished with some 2000 well-chosen examples. Naturally it is possible to criticise certain portions on the ground of absence of rigidity. But probably the authors have hit the happy mean between a slovenliness which demoralises the beginner and a precision which terrifies him.

It is interesting to contrast the American and English ideas of a suitable syllabus for the first two years of a "pass" mathematical course. The Americans include the co-ordinate geometry of straight line and plane; but the rest of the syllabus consists almost entirely of the calculus and elementary differential equations. Even the circle and conic receive no more than a passing mention; and very little algebra is inserted, such subjects as determinants and the theory of equations being deferred for subsequent study. Contrast this with a certain English B.A. course, which demands no calculus whatever, but requires the "simple properties of conic sections, including a discussion of the general equation of the second degree and the methods of projection"! The book under review may give the student a somewhat false idea of the importance of the conic (it is mentioned casually along with the witch, the cissoid, and the strophoid), and he may find partial differentiation studied by means of three-dimensional coordinate geometry a little too hard for him. But, nevertheless, English teachers have very much to learn from their allies. H. H.

OUR BOOKSHELF.

The Botany of Iceland. Edited by Dr. L. Kolderup Rosenvinge and Dr. Eug. Warming. Part ii. 3. Ernst Østrup: "Marine Diatoms from the Coasts of Iceland." 4. Aug. Hesselbo: "The Bryophyta of Iceland." Pp. 348–675. (Copenhagen: J. Frimodt; London: J. Wheldon and Co., 1918.) Price 11*s*. net.

THIS part completes vol. i. of "The Botany of Iceland," the first part of which was issued in two sections, one on "The Marine Algal Vegetation," by H. Jónsson, in 1912, and a second on "The Physical Geography of the Island," in 1914.

The list of marine diatoms from the coasts of Iceland comprises 209 species and varieties; seven species and a number of varieties are here described as new. Mr. Østrup gives a tabular list showing the universal distribution of the forms, as well as their distribution on the different parts of the coasts of Iceland from which it